



JEE MAIN PATTERN
FST # 03 | 03-01-2019

Time: 3 Hours

SCORE-1

Maximum Marks : **360**

PAPER & SOLUTIONS

Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.

- This booklet contains 31 printed pages.**
(i) Page No. 1 to 15 Question paper
(ii) Page No. 16 to 31 Answer key and Solutions
- The Test Booklet consists of **90** questions. The maximum marks are 360.
- There are three parts in the question paper A, B, C consisting of Physics, Mathematics and Chemistry having 30 questions in each part of equal weightage. Each question is allotted **4** (four) marks for correct response.
- Candidates will be awarded marks as stated above in instruction No. 3 for correct response of each question. $\frac{1}{4}$ (**one-fourth**) marks of the total marks allotted to the question (i.e. 1 mark) will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.
- There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 4 above.
- No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. except the Admit Card inside the examination room/hall.
- Rough work is to be done on the space provided for this purpose in the Test Booklet only. This space is given at the bottom of each page.
- On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room/Hall.
However, the candidates are allowed to take away this Test Booklet with them.
- Do not fold or make any stray mark on the Answer Sheet

Name of the Candidate

I have read all the instructions and shall abide by them.

Signature of the Candidate

Form Number

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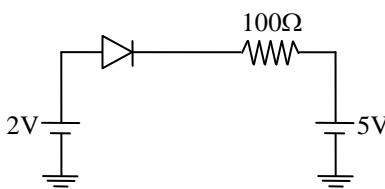
I have verified all the information filled in by the Candidate.

Signature of the invigilator

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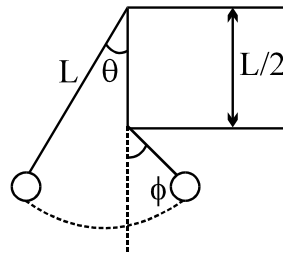
PART-A : PHYSICS

- Range of frequencies allotted for commercial FM radio broadcast is -
 (1) 88 to 108 MHz (2) 88 to 108 kHz (3) 8 to 88 MHz (4) 88 to 108 GHz
- Through which mode of propagation, the radio waves can be sent from one place to another.
 (1) Ground wave propagation (2) Sky wave propagation
 (3) Space wave propagation (4) All of them
- The pitch of a screw gauge is 0.5 mm and there are 100 divisions on its circular scale. The instrument reads +2 circular scale divisions when nothing is put in-between its jaws. In measuring the diameter of a wire, there are 8 divisions on the main scale and 83rd circular scale division coincides with the reference line. Then the diameter of the wire is
 (1) 4.05 mm (2) 4.405 mm (3) 3.05 mm (4) 1.25 mm
- Current through the ideal diode is –

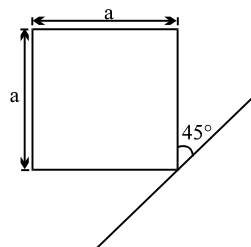


- (1) zero (2) 20 A (3) $\frac{1}{20}$ A (4) $\frac{1}{50}$ A
- Pure Si at 500K has equal number of electron (n_e) and hole (n_h) concentrations of $1.5 \times 10^{16} \text{ m}^{-3}$. Doping by indium increases n_h to $4.5 \times 10^{22} \text{ m}^{-3}$. The doped semiconductor is of :
 (1) n-type with electron concentration $n_e = 5 \times 10^{22} \text{ m}^{-3}$
 (2) p-type with electron concentration $n_e = 2.5 \times 10^{10} \text{ m}^{-3}$
 (3) n-type with electron concentration $n_e = 2.5 \times 10^{23} \text{ m}^{-3}$
 (4) p-type having electron concentrations $n_e = 5 \times 10^9 \text{ m}^{-3}$
 - When a beam of accelerated electrons hits a target, which one of the following wavelengths is absent in the X-ray region of the spectrum, if the tube is operated at 40000 V?
 (1) 1.5 Å (2) 1.0 Å (3) 0.5 Å (4) 0.25 Å
 - When electrons collide with an atom, they can transfer some or all of their energy to the atom. Suppose a hydrogen atom in its ground state is struck by an electron having a kinetic energy of 10.5 eV. The result can be that
 (1) the atom is excited to $n = 2$ (2) the atom is ionized.
 (3) the atom is excited to $n = 3$ (4) the electron can enter the hydrogen nucleus.

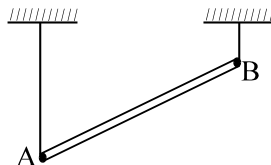
8. Figure shows a pendulum of length L suspended from the top of a flat beam of height $L/2$. The bob is pulled away from the beam so it makes an angle θ with the vertical. Now, it is released from rest. If ϕ is the maximum angular deflection to the right, then



- (1) $\phi = \theta$ (2) $\phi < \theta$ (3) $\theta < \phi \leq 2\theta$ (4) $\phi > 2\theta$
9. Which of the following statements is true concerning the elastic collision of two objects?
- (1) No work is done on any of the two objects, since there is no external force.
 (2) The work done by the first object on the second is equal to the work done on the first by the second
 (3) The work done by the first object on the second is exactly the negative of the work done on the first by the second.
 (4) The work done on the system depends on the angle of collision.
10. The moment of inertia of a thin sheet of mass M of the given shape about the specified axis is (axis is in the plane of body)



- (1) $\frac{7}{12}Ma^2$ (2) $\frac{5}{12}Ma^2$ (3) $\frac{1}{3}Ma^2$ (4) $\frac{1}{12}Ma^2$
11. Two strings support a uniform rod as shown. String at end B is cut. Which of the following is true just after cut



- [I] initial acceleration of A is vertical
 [II] initial acceleration of A is horizontal
 [III] initial acceleration of centre of mass of rod is vertical
 [IV] initial acceleration of centre of mass of rod is horizontal

- (1) [I] & [II] (2) [II] & [III] (3) [III] & [IV] (4) [I] & [IV]

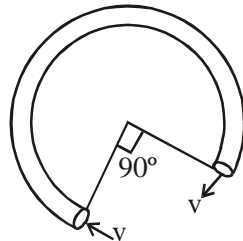
12. The height of mercury column measured with a brass scale at temperature t_1 is n_1 units. Height of the mercury column measured by brass scale at $t = 0^\circ\text{C}$ is n_2 units. The coefficient of linear expansion of brass is α and coefficient of volume expansion of mercury is γ . (Assume the expansion in area of vessel containing mercury is negligible). $n_2 =$

(1) $n_1 (1 - \alpha t_1)$ (2) $\frac{n_1(1 + \alpha t_1)}{1 + (\gamma/3)t_1}$ (3) $\frac{n_1(1 - \gamma t_1)}{(1 - \alpha t_1)}$ (4) $\frac{n_1(1 - \alpha t_1)}{(1 - \gamma t_1)}$

13. A refrigerator consuming P watts, converts mass 'q' of water into ice in t minutes at a temperature θ . What quantity of heat will be liberated by the refrigerator in a room during this time if the heat capacity of refrigerator is neglected? ($c =$ specific heat of water, $L =$ latent heat of fusion of ice)

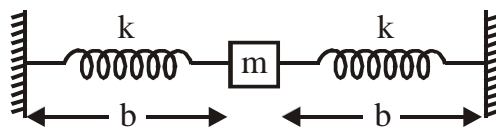
(1) $- 60 Pt + qc\theta + qL$ (2) $60 Pt - qc\theta + qL$ (3) $60 Pt - qc\theta - qL$ (4) $60Pt + qc\theta + qL$

14. A tube of uniform cross section A is bent to form a circular arc of radius R , forming three quarters of a circle. As liquid of density ρ is forced through the tube with a linear speed v as shown in the figure. The net force exerted by the liquid on the tube is :



(1) $\frac{3}{2}\rho AV^2$ (2) $\frac{1}{4}\rho AV^2$ (3) $\sqrt{2}\rho AV^2$ (4) zero

15. In the figure shown, a block of mass m is rigidly attached to two identical springs of stiffness k each with other ends of the springs connected to the fixed walls. When the block is in equilibrium, length of each spring is b , which is greater than the natural length ℓ of the spring. The time period of the oscillation of the block if it is displaced by small distance x perpendicular to the length of the spring and released (Assume motion of the block is in gravity free space) is :-

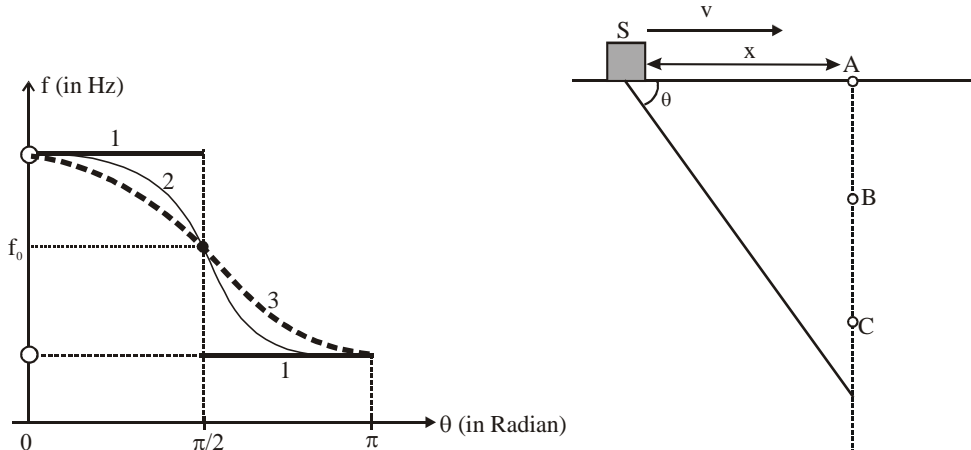


(1) $2\pi\sqrt{\frac{mb}{k(b-\ell)}}$ (2) $2\pi\sqrt{\frac{mb}{2k(b-\ell)}}$ (3) $\sqrt{\frac{m(b-\ell)}{kb}}$ (4) $2\pi\sqrt{\frac{m(b-\ell)}{2kb}}$

16. Two wires of same material and radii r and $2r$ respectively are welded together end to end and the combination is used in the sonometer and is kept under tension T . The welded point is midway between the bridges in the sonometer. What should be the ratio of number of loops formed in wires such that the joint is a node?

(1) 2:3 (2) 1:4 (3) 1:2 (4) 1:3

17. A source is moving with a constant speed u on a straight line, emitting a sound of frequency f_0 . There are three observers A, B and C. A on track, B at a perpendicular distance of d from the track and C at a perpendicular distance of $2d$ from the track as shown in the figure. The variation of the observed frequency with respect to the position x ,

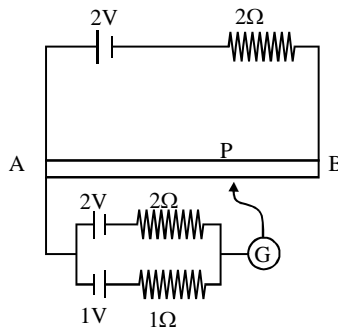


- (1) A – 3, B – 2, C – 1 (2) A – 2, B – 3, C – 1
 (3) A – 1, B – 2, C – 3 (4) A – 1, B – 3, C – 2

18. The potential on the N^{th} shell due to N concentric shells having charges $Q, 2Q, 3Q, \dots, NQ$ and radii $a, 2a, 3a, \dots, Na$ respectively is-

- (1) $\frac{Q(N+1)}{8\pi \epsilon_0 A}$ (2) $\frac{QN(N+1)}{8\pi \epsilon_0 A}$ (3) $\frac{Q}{2\pi \epsilon_0 A}$ (4) $\frac{Q(N+1)}{2\pi \epsilon_0 A}$

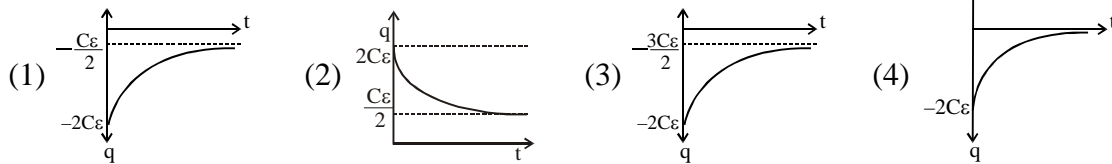
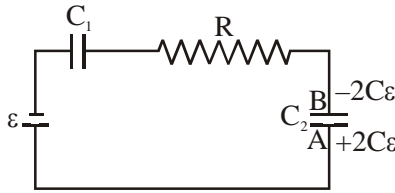
19. A battery of emf $2V$ is connected across a long uniform wire AB of length $1m$ and resistance per unit length $2\Omega m^{-1}$. Two cells of emf $\epsilon_1 = 1V$ and $\epsilon_2 = 2V$ are connected as shown in the figure. If the galvanometer shows no deflection at point P , the distance of point P from point A is equal to



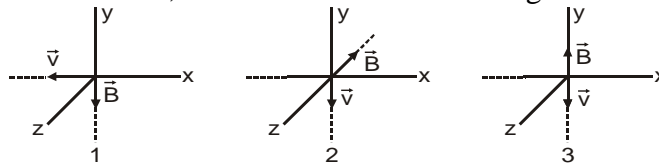
- (1) 0 (2) 50 cm (3) 100 cm (4) 25 cm

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20. The capacitance of C_1 and C_2 shown in the diagram is C . C_1 is initially uncharged and C_2 is given a charge $2C\epsilon$ as shown. Which of the following graph represents charge on plate B of capacitor C_2 as a function of time ?



21. The figure shows three situations when an electron with velocity \vec{v} travels through a uniform magnetic field \vec{B} . In each case, what is the direction of magnetic force on the electron?



- (1) positive z-axis, negative x-axis, positive y-axis
 (2) negative z-axis, negative x-axis and zero
 (3) positive z-axis, positive y-axis and zero
 (4) negative z-axis, positive x-axis and zero

22. The circumference of the second Bohr orbit of electrons in hydrogen atom is 600 nm. The potential through which a free electron must be accelerated so that the electron have the de-Broglie wavelength corresponding to this circumference, is [Take : $h = 6.6 \times 10^{-34}$ Js]

- (1) 7×10^{-5} V (2) $\frac{5}{3} \times 10^{-5}$ V (3) 5×10^{-5} V (4) 3×10^{-5} V

23. Match the entries of column-I with the entries of column-II :-

Column-I	Column-II
(i) Mass defect	(P) Participating nuclei are small
(ii) Nuclear fission	(Q) Participating nuclei are large
(iii) Nuclear fusion	(R) $E = \Delta mc^2$

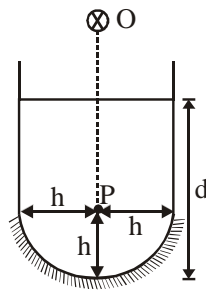
Then choose the correct matching.

- (1) (i) \rightarrow (R) ; (ii) \rightarrow (QR) ; (iii) \rightarrow (PR) (2) (i) \rightarrow (R) ; (ii) \rightarrow (PR) ; (iii) \rightarrow (QR)
 (3) (i) \rightarrow (R) ; (ii) \rightarrow (Q) ; (iii) \rightarrow (P) (4) (i) \rightarrow (R) ; (ii) \rightarrow (P) ; (iii) \rightarrow (Q)

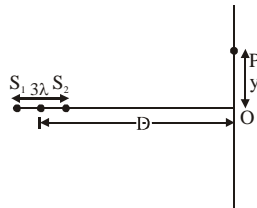
24. A charged capacitor discharges through a resistance R with time constant τ . The two are now placed in series across an AC source of angular frequency $\omega = \frac{1}{\tau}$. The impedance of the circuit will be-

- (1) $\frac{R}{\sqrt{2}}$ (2) R (3) $\sqrt{2}R$ (4) $2R$

25. A concave mirror of radius h is placed at the bottom of a tank containing a liquid of refractive index μ upto a depth d . An object P is placed at height h above the bottom of the mirror. Outside the liquid, an observer O views the object and its image in the mirror. The apparent distance between these two will be :-



- (1) zero (2) $\frac{2h}{\mu}$ (3) $h\left(1 - \frac{1}{\mu}\right)$ (4) $\frac{2h}{\mu - 1}$
26. What is the phase difference between electric field & magnetic field in an electromagnetic wave:-
- (1) 0 (2) $\frac{\pi}{2}$ (3) π (4) $\frac{\pi}{4}$
27. Figure shows two coherent microwave source S_1 and S_2 emitting waves of wavelength λ and separated by a distance 3λ . For $\lambda \ll D$ and $y \neq 0$, the minimum value of y for point P to be an intensity maximum is



- (1) $\frac{D\sqrt{5}}{2}$ (2) $\frac{D\sqrt{7}}{2}$ (3) $\frac{D\sqrt{3}}{2}$ (4) $\frac{D\sqrt{15}}{2}$
28. The hysteresis cycle for the material of permanent magnet is -
 (1) Short and wide (2) Tall and narrow (3) Tall and wide (4) Short and narrow
29. In a compound microscope, the focal lengths of two lenses are 1.5 cm and 6.25 cm an object is placed at 2 cm from objective and the final image is formed at 25 cm from eye lens. The distance between the two lenses is -
 (1) 6.00 cm (2) 7.75 cm (3) 9.25 cm (4) 11.00 cm
30. The magnification produced by an astronomical telescope for normal adjustment is 10 and the length of telescope is 1.1m. The magnification when image is formed at least distance of distinct vision ($D = 25$ cm) is -
 (1) 14 (2) 6 (3) 16 (4) 18

PART-B : MATHEMATICS

31. Let $y = x + e^x$, then at $x = 0$; $\frac{d^2x}{dy^2}$ is equal to
 (1) $\frac{1}{2}$ (2) $\frac{-1}{2}$ (3) $\frac{1}{4}$ (4) $\frac{-1}{8}$
32. Find the rank of the word "IITJEE", if all the words are arranged in the order of English dictionary.
 (1) 94 (2) 96 (3) 95 (4) 97
33. If $\int \left(\frac{x^2 - x + 1}{x^2 + 1} \right) \cdot e^{\cot^{-1}x} dx = A(x) \cdot e^{\cot^{-1}x} + C$, where C is constant of integration, then A(x) is equal to
 (1) $-x$ (2) $\sqrt{1-x}$ (3) x (4) $\sqrt{1+x}$
34. The value of $\lim_{x \rightarrow 0} \frac{e^{2x} - \cos x - \ln(1+2x)}{\cos 5x - \cos x}$ equals
 (1) $\frac{9}{24}$ (2) $\frac{-9}{24}$ (3) $\frac{24}{9}$ (4) $\frac{-24}{9}$
35. Equation of plane containing the line $x + 2y + 3z - 5 = 0 = 3x + 2y + z - 5$ which is parallel to line $x - 1 = 2 - y = z - 3$, is
 (1) $x + 2y + z = 0$ (2) $x - z = 0$ (3) $2y + 2z = 1$ (4) $x + 4y + 3z = 0$
36. Let A & B are two non singular matrices of order 3 such that $A + B = I$ & $A^{-1} + B^{-1} = 2I$, then $|\text{adj}(4AB)|$, is (where $\text{adj}(A)$ is adjoint of matrix A)-
 (1) 4 (2) 16 (3) 64 (4) 128
37. Let $f(x) = \frac{x}{\sqrt{x^2 - 1}}$ and $g(x) = f(\underbrace{f(f(\dots f(f(x))))}_{2018 \text{ times}})$, then $\int_0^{2018} \{g(x)\} dx$ is equal to
 [Note : $\{ \cdot \}$ denotes fractional part function.]
 (1) 2018 (2) 4096 (3) 1009 (4) $\frac{1009}{2}$
38. If $f(x) = \begin{cases} \text{sgn}(x-2)[\ln x] & ; 1 \leq x \leq 3 \\ \{x^2\} & ; 3 < x \leq 4 \end{cases}$ then the number of points in $[1, 4]$ where $f(x)$ is discontinuous is
 [Note : where $[\cdot]$ and $\{ \cdot \}$ denote greatest integer function and fractional part function respectively $\text{sgn}(\cdot)$ denotes signum function]
 (1) 7 (2) 8 (3) 9 (4) 10

39. If $f(x) = e^{2x} - c^2e^x + 2x + \cos 2 + \sin 1$, is monotonically increasing for all $x \in \mathbb{R}$, then the largest integral value of c is
 (1) 1 (2) 2 (3) 3 (4) 4
40. A polynomial $f(x)$ of degree 6 satisfies $f(x) = f(3 - x) \forall x \in \mathbb{R}$. If $f(x) = 0$ has 4 distinct and two equal roots, then the sum of the root of $f(x) = 0$ is
 (1) 0 (2) 4 (3) 6 (4) 9
41. Let $f: [-20, 20] \rightarrow [a, b]$ $f(x) = \tan^{-1}x + x^5 + \sin x + x$ be an onto function then
 (1) $3a + b < 0$ (2) $3a + b > 0$ (3) $a + 2b < 0$ (4) $3a + 4b < 0$
42. Let A & B are two independent events such that $P(A) + P(B) = \frac{3}{4}$ & $P(\bar{A} / B) = \frac{2}{5}$, then $P(A \cap B)$ is-
 (1) $\frac{9}{20}$ (2) $\frac{9}{100}$ (3) $\frac{5}{17}$ (4) $\frac{6}{20}$
43. If curves $C_1 : y^2 = 2ax$ ($a > 0$) and $C_2 : xy = 4\sqrt{2}$ intersect orthogonally, then a equals
 (1) $\frac{1}{2}$ (2) $\frac{2}{3}$ (3) 2 (4) $\frac{3}{2}$
44. The value of $\lim_{x \rightarrow 0} \frac{x \int_0^{x^2} \tan^{-1}(t) dt}{x^3 - \sin^3 x}$ is equal to
 (1) 1 (2) 0 (3) 2 (4) -2
45. The value of $\frac{\cos 62^\circ}{\sin 52^\circ \sin 66^\circ} + \frac{\cos 52^\circ}{\sin 66^\circ \sin 62^\circ} + \frac{\cos 66^\circ}{\sin 62^\circ \sin 52^\circ}$ is equal to
 (1) -2 (2) 2 (3) 1 (4) $2 + \sqrt{3}$
46. The number of solution(s) of the equation $\sin^3 x \cos x + \sin^2 x \cos^2 x + \sin x \cos^3 x + \frac{1}{4} = 0$ in the interval $[0, 2\pi]$ is/are
 (1) 0 (2) 1 (3) 2 (4) 3
47. If one of the roots of $2x^2 - 6x + 5 = 0$ and $(a - b)x^2 + (a + 2b)x + 15 = 0$ is common then $\log_{\left(\frac{1}{-a}\right)}\left(\frac{1}{-b}\right)$ is equal to (where $a, b \in \mathbb{R}$)
 (1) $\frac{1}{7}$ (2) $\frac{1}{3}$ (3) 3 (4) non-defined

48. The sum of series $\frac{1}{2 \cdot 1} + \frac{2}{3 \cdot 2 \cdot 1} + \frac{3}{4 \cdot 3 \cdot 2 \cdot 1} + \dots + \frac{99}{100 \cdot 99 \cdot 98 \dots 3 \cdot 2 \cdot 1}$ is
 (1) 1 (2) $\frac{1}{100 \cdot 99 \cdot 98 \dots 1}$ (3) $1 + \frac{1}{100 \cdot 99 \dots 1}$ (4) $1 - \frac{1}{100 \cdot 99 \cdot 98 \dots 1}$
49. A straight line through A(6, 8) meets the curve $2x^2 + y^2 = 2$ at B and C, P is a point on BC such that AB, AP, AC are in H.P., then the minimum distance of the origin from the locus of P is
 (1) $\frac{1}{\sqrt{52}}$ (2) $\frac{5}{\sqrt{52}}$ (3) $\frac{10}{\sqrt{52}}$ (4) $\frac{15}{\sqrt{52}}$
50. Two circles are drawn through the points A(3, 2) and B(-1, 4) to touch the x-axis. If the distance between their centres is k times of AB. Then the value of k is
 (1) $20\sqrt{2}$ (2) $2\sqrt{5}$ (3) $2\sqrt{10}$ (4) 6
51. The lines $4x + 2y + 16 = 0$ and $2x + y + 13 = 0$ are the tangents of a circle and the line $x - 2y - 1 = 0$ passes through centre of the circle, then equation of the circle is
 (1) $(x - 3)(x + 5) + (y + 2)(y + 3) = 0$ (2) $(x + 3)(x - 5) + (y + 2)(y + 3) = 0$
 (3) $(x + 3)(x + 5) + (y - 2)(y + 3) = 0$ (4) $(x + 3)(x + 5) + (y + 2)(y + 3) = 0$
52. From line $3x + 4y = 12$, pair of tangents are drawn to ellipse $\frac{x^2}{4} + \frac{y^2}{1} = 1$. The fixed point through which chord of contact always pass through is
 (1) $\left(\frac{1}{4}, \frac{1}{3}\right)$ (2) $\left(\frac{1}{3}, \frac{1}{4}\right)$ (3) $\left(1, \frac{1}{3}\right)$ (4) $\left(\frac{1}{4}, \frac{1}{4}\right)$
53. The locus of the foot of the perpendicular from origin to a variable tangent of the hyperbola $xy = 4$ is
 (1) $x^2 - y^2 = 16xy$ (2) $x^2 + y^2 = 16xy$ (3) $(x^2 - y^2)^2 = 16xy$ (4) $(x^2 + y^2)^2 = 16xy$
54. Pair of tangents are drawn from every point on the line $x + y = 4$ to the ellipse $\frac{x^2}{9} + \frac{y^2}{4} = 1$, then locus of mid points of the chord of contact is
 (1) $4x^2 + 3y^2 = x + y$ (2) $4x^2 + 9y^2 = 9x + 9y$
 (3) $4y^2 + 9x^2 = x + y$ (4) $4y^2 + 9x^2 = 9x + 9y$
55. The standard deviation of the numbers : -2, 1, 4, 7, 10, -5, 13 is
 (1) 1 (2) 3 (3) 6 (4) 12

56. If $f(x) = \int_0^x (e^t + 3)dt$, then which of the following is always true $\forall x \in \mathbb{R}$

(1) $f(x - 3) - f(x - 1) \leq 11$

(2) $f(x + 1) - f(x - 1) \leq 11$

(3) $f(x + 3) - f(x - 5) \geq 24$

(4) $f(x) + f(x + 1) < -21$

57. The constant term in the expansion of $\left(x + x^2 + \frac{1}{x} + \frac{1}{x^2}\right)^{15}$ is

(1) ${}^{15}C_0$

(2) ${}^{30}C_{15}$

(3) $2 \cdot {}^{15}C_0$

(4) $\sum_{r=0}^5 {}^{15}C_{5+r} {}^{15}C_{3r}$

58. The equation of curve passing through (1, 1) in which subtangent is always bisected at origin is

(1) $y^2 = x$

(2) $2x^2 - y = 1$

(3) $x^2 + y^2 = 2$

(4) $x + y = 2$

59. Let a be a real number

and $\vec{\alpha} = \hat{i} + 2\hat{j}$

$\vec{\beta} = 2\hat{i} + a\hat{j} + 10\hat{k}$

$\vec{\gamma} = 12\hat{i} + 2a\hat{j} + a\hat{k}$

be three vectors then

$\vec{\alpha}, \vec{\beta}$ and $\vec{\gamma}$ are

(1) Linearly dependent for all a

(2) Linearly independent for all a

(3) Linearly dependent for $a < 0$ only

(4) Linearly dependent for $a > 0$ only

60. The compound statement $(p \rightarrow q) \rightarrow (\sim q \rightarrow \sim r)$ is true. If p is true and q is false then statement "r"

(1) is true only

(2) is false only

(3) can be both true or false

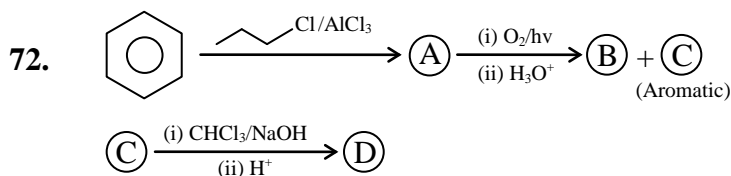
(4) not possible

PART-C : CHEMISTRY

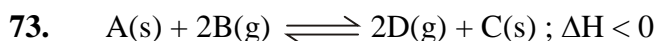
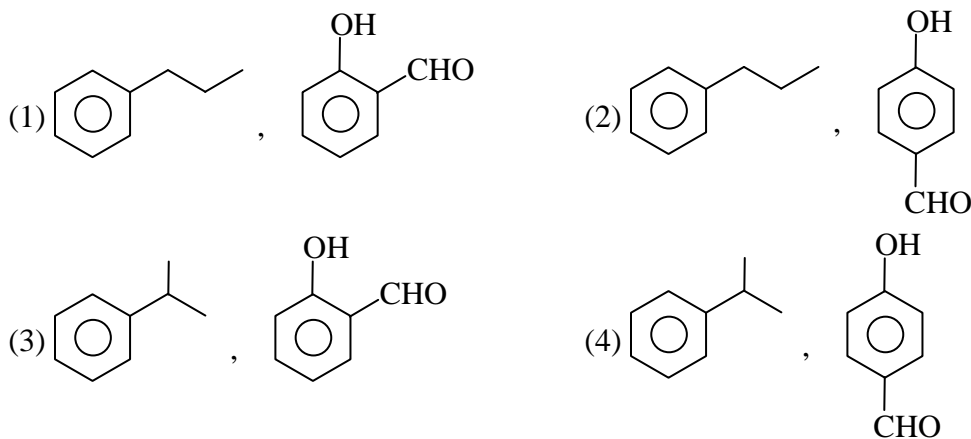
61. On passing electricity through dilute H_2SO_4 solution the mass ratio of gases liberated at the cathode and anode are in the ratio :
 (1) 1 : 8 (2) 8 : 11 (3) 16 : 1 (4) 1 : 16
62. For an electron magnetic quantum number : +3. The electron may be present in :
 (1) 5p (2) 6d (3) 4s (4) 4f
63. D-Glucose and D-fructose can be differentiated by which of the following test:
 (1) 2, 4-DNP test (2) Tollen's test (3) Br_2 /water test (4) Luca's test
64. Depression of freezing point of 0.01 molar aq. CH_3COOH solution is 0.0205°C . 1 molal urea solution freezes at -1.86°C . Assuming molality equal to molarity, pH of CH_3COOH solution is:
 (1) 2 (2) 2.4 (3) 3 (4) 4
65. Select the incorrect order related to given properties :
 (1) $\text{Al}^{+3} > \text{Be}^{+2}$ (ionic radii) (2) $\text{Li}^+_{(\text{aq})} < \text{Na}^+_{(\text{aq})}$ (ionic mobility)
 (3) $\text{Be}^{+2}_{(\text{aq})} < \text{Mg}^{+2}_{(\text{aq})}$ (hydrated size) (4) $\text{Be}^{+2} > \text{Al}^{+3}$ (charge density)
66. Which statement among following is correct:
 (1) Uracil is a N-base present in DNA but not in RNA.
 (2) Vitamin-A is a fat soluble
 (3) When Ortho-salicylic acid react with $\text{Me-OH}/\text{H}^+$ form aspirin.
 (4) Deficiency of vitamin-D causes night blindness.
67. Which of the following is correct?
 (1) Molecularity of rate determining step is always equal to the order of the reaction.
 (2) For the same rise of temperature, the % rise in the value of rate constant will be more for the reaction whose energy of activation is higher.
 (3) At the same temperature and for the same reaction $\Delta H_{(\text{Catalysed})} < \Delta H_{(\text{Uncatalysed})}$
 (4) Rate of a zero order reaction always depends upon the concentration of catalyst.
68. Choose the correct order of strength of H-bond :
 (1) $\text{H}_2\text{O} > \text{H}_2\text{O}_2$ (2) $\text{H}_2\text{O} < \text{NH}_3$ (3) $\text{HF} < \text{H}_2\text{O}$ (4) $\text{NH}_3 > \text{HF}$
69. The structure of glycine at pH 3.0 is:
 (1) $\text{H}_3\text{N}^{\oplus}-\text{CH}_2-\text{COO}^{\ominus}$ (2) $\text{H}_2\text{N}-\text{CH}_2-\text{COO}^{\ominus}$
 (3) $\text{H}_3\text{N}^{\oplus}-\text{CH}_2-\text{COOH}$ (4) $\text{H}_2\text{N}-\text{CH}_2-\text{COOH}$

70. Select the incorrect statement from the following :
- (1) In mono-molecular layer adsorption, rate of adsorption first increases then decreases with increase in temperature.
 - (2) Lyophobic colloidal particles do not settle down under the force of gravity even on ultra centrifugation.
 - (3) Standard enthalpy of dissociation of $\text{H}_2\text{O}(\ell)$ into its aqueous ions at 298 K is nearly 57.1 kJ/mole.
 - (4) Molar entropies of pure monoclinic sulphur and pure rhombic sulphur become same at absolute zero temperature.

71. Select the incorrect match of process and metal in metallurgical extraction :
- (1) Leaching - Ag
 - (2) Zone refining - Sn
 - (3) Mond's process - Ni
 - (4) Van - arkel - Ti



By considering major product in each step. Identify compound A and D among following.



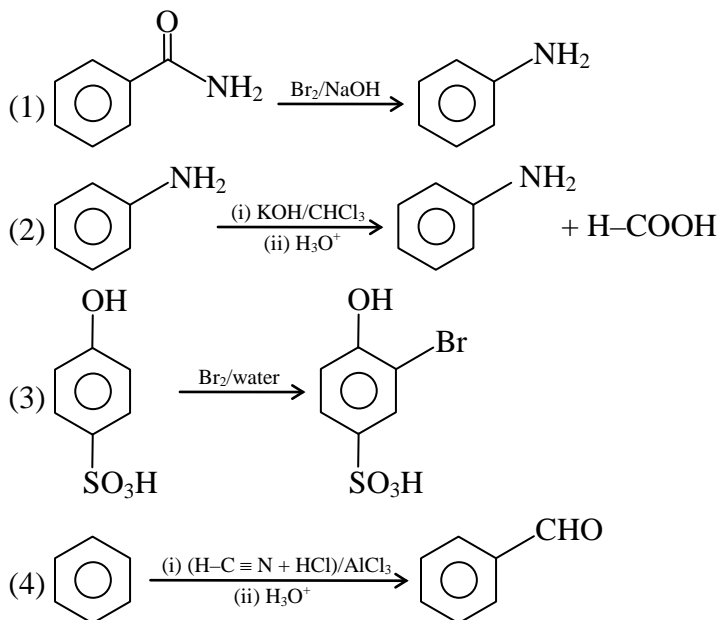
The above equilibrium was established by initially taking $\text{A}(\text{s})$ and $\text{B}(\ell)$ in a closed container. Vapour pressure of $\text{B}(\ell)$ is constant at a particular temperature. Which of the following are incorrect statements :

- (1) Equilibrium pressure of $\text{D}(\text{g})$ remains constant on adding more $\text{B}(\ell)$ at equilibrium.
- (2) On increase in temperature total equilibrium pressure is surely increase.
- (3) On decrease in volume of container total equilibrium pressure remains constant.
- (4) On adding more $\text{D}(\text{g})$ in the container total equilibrium pressure remains constant.

74. Which of the following complex is most stable ?

- (1) $[\text{Co}(\text{H}_2\text{O})_6]\text{Cl}_3$ (2) $\text{K}_3[\text{Co}(\text{CN})_6]$ (3) $\text{K}_3[\text{Co}(\text{OX})_3]$ (4) $\text{K}_3[\text{CoF}_6]$

75. The reaction among following not correctly matched with major product:

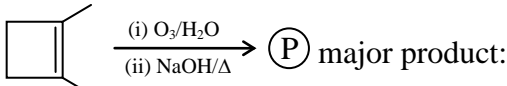


76. Electron in a sample of H atoms are returned to ground state from an excited state so that change in de-Broglie wavelength of electron corresponding to the transition of maximum energy is equal to $(\pi \times 8 \times 0.529) \text{ \AA}$. Select correct option

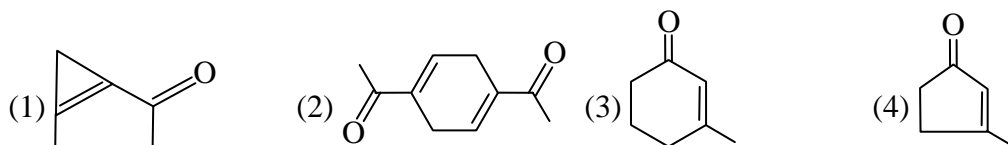
- (1) Number of orbit of original excited state is 4.
 (2) Total number of different spectral lines in visible region is 4.
 (3) Total number of different spectral lines in infrared region is 3.
 (4) Change in angular momentum of electron corresponding to the transition of minimum energy = $2 \hbar$

77. Which of the following cations gives crimson red colour in flame ?

- (1) Cs^+ (2) Ba^{2+} (3) Sr^{2+} (4) K^+

78.  major product:

Major product 'P' formed in above reaction is:

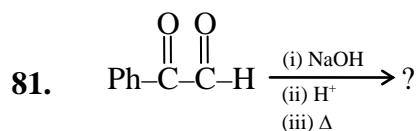


79. A sample of water has a hardness expressed as 80 ppm of Ca^{2+} . This sample is passed through an ion exchange column and the Ca^{2+} is replaced by H^+ . What is the pH of the water after this treatment? [Atomic mass of Ca = 40]

- (1) 3 (2) 2.7 (3) 5.4 (4) 2.4

80. Which of the following hydride is electron deficient?

- (1) SiH_4 (2) CaH_2 (3) AlH_3 (4) KH



Total number of product(s) formed in above reaction is/are:

- (1) 1 (2) 2 (3) 3 (4) 4

82. Four samples of ideal gas containing same moles and initially at same temperature and pressure are subjected to four different process

- (i) Isothermal reversible expansion
(ii) Isothermal irreversible expansion against final pressure
(iii) Adiabatic reversible expansion
(iv) Adiabatic irreversible expansion against final pressure.

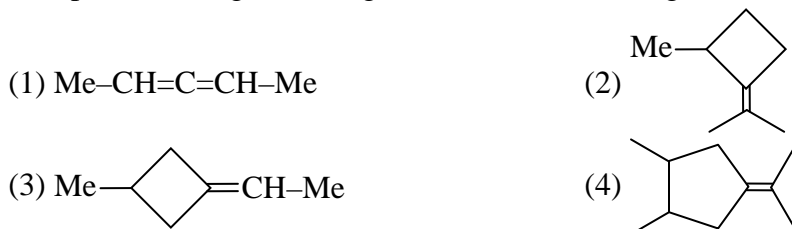
If in all the cases, final pressure is same then what will be the order of final temperature in the above cases (T_a, T_b, T_c, T_d are final temperature of process (i), (ii), (iii), (iv) respectively)

- (1) $T_a = T_b > T_c = T_d$ (2) $T_a > T_b > T_c > T_d$ (3) $T_a = T_b < T_c < T_d$ (4) $T_a = T_b > T_d > T_c$

83. Which of the following is a covalent halide?

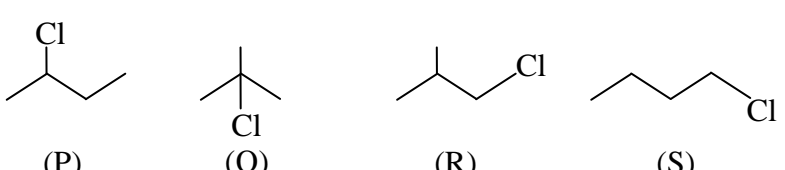
- (1) LiF (2) BeF_2 (3) AlF_3 (4) MgF_2

84. Compound among following which can show both geometrical and optical isomerism.



85. pH of which of the following solution is affected by moderate dilution ?

- (1) 0.01 M NaHC_2O_4
(2) Mixture of a 0.01 M CH_3COONa and 0.01 M CH_3COOH
(3) 0.01 M CH_3COONa
(4) 0.01 M $\text{CH}_3\text{COONH}_4$

86. Which of the following element is not an f-block element?
 (1) No (2) Nd (3) Nb (4) Np
87. Suitable reagent to convert But-2-yne into But-1-yne
 (1) NaNH_2/H^+ (2) KOH/H^+
 (3) $\text{HCl}(\text{excess})/\text{KOH}(\text{excess})/\Delta$ (4) $\text{Cl}_2(\text{excess})/\text{Zn}(\text{excess})/\Delta$
88. In NaCl type structure the distance between two nearest Cl^- is $100\sqrt{2}$ pm. Find the distance between two nearest Na^+ will be (in pm) : (Assume that nearest Cl^- are in contact to each other).
 (1) $100\sqrt{2}$ (2) 100 (3) $\frac{100}{\sqrt{2}}$ (4) $200\sqrt{2}$
89. The incorrect order for lewis basic strength is :
 (1) $\bar{\text{C}}\text{Cl}_3 < \bar{\text{C}}\text{F}_3$ (2) $(\text{CH}_3)_2\text{O} < \text{O}(\text{SiH}_3)_2$
 (3) $(\text{CH}_3)_3\text{N} > \text{N}(\text{SiH}_3)_3$ (4) $\text{NH}_3 > \text{PH}_3$
90. The correct order of reactivity of following compound towards SN^1 reaction is:

 (1) $\text{P} > \text{Q} > \text{R} > \text{S}$ (2) $\text{Q} > \text{P} > \text{R} > \text{S}$ (3) $\text{Q} > \text{P} > \text{S} > \text{R}$ (4) $\text{Q} > \text{R} > \text{P} > \text{S}$